AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Application No.: 10/678,632
Attorney Docket No.: Q77799

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

Claim 1 (Canceled)

2. (Currently Amended) ~~The light source type discriminating method according to claim 1~~A light source type discriminating method for discriminating a light source type of a photographic light source, comprising the steps of:

providing first to third sensors respectively having spectral sensitivities corresponding to three primary colors;

arranging a fourth sensor having a spectral sensitivity that does not overlap said spectral sensitivities corresponding to said three primary colors, said first to fourth sensors constituting an image pickup system; and

discriminating said light source type of said photographic light source by using information obtained by said first to fourth sensors, wherein:

said fourth sensor is a sensor in which a value of an average minimum distance L_{min} indicating light source similarity between respective light sources whose types are to be discriminated is at least equal to a predetermined first reference value, said average minimum distance L_{min} being represented by an expression:

$$L_{min} = \Sigma\ L(i)j_{min}/m \quad \ldots\ldots \quad (1)$$

where L_{min} is the average minimum distance, L(i)j is a similarity between a reference light source (i) and another light source (j) and m is a number of types of light sources, and being obtained based on differences between respective sensor signals of said reference light source (i) and respective sensor signals of said another light source (j).

3. (Original) The light source type discriminating method according to claim 2, wherein said first reference value is set at 1.2.

Claims 4 (Canceled)

5. (Currently Amended) ~~The light source type discriminating method according to claim 1~~A light source type discriminating method for discriminating a light source type of a photographic light source, comprising the steps of:

providing first to third sensors respectively having spectral sensitivities corresponding to three primary colors;

arranging a fourth sensor having a spectral sensitivity that does not overlap said spectral sensitivities corresponding to said three primary colors, said first to fourth sensors constituting an image pickup system; and

discriminating said light source type of said photographic light source by using information obtained by said first to fourth sensors, wherein:

said first to third sensors for said three primary colors are respectively a red (R) sensor, a green (G) sensor, and a blue (B) sensor; and

said fourth sensor is a sensor whose absorption peak exists between respective absorption peaks of said G sensor and said B sensor and in a region of from 500 nm to 520 nm.

6. (Currently Amended) ~~The light source type discriminating method according to claim 1~~A light source type discriminating method for discriminating a light source type of a photographic light source, comprising the steps of:

providing first to third sensors respectively having spectral sensitivities corresponding to three primary colors;

arranging a fourth sensor having a spectral sensitivity that does not overlap said spectral sensitivities corresponding to said three primary colors, said first to fourth sensors constituting an image pickup system; and

discriminating said light source type of said photographic light source by using information obtained by said first to fourth sensors, wherein said discriminating step comprises:

obtaining a second reference value through one of summation and integration of products of spectral energy distributions of light sources whose color temperatures are each based on known black body radiation, spectral energy distributions of fluorescent lamps whose spectral energy distributions are prescribed, a spectral sensitivity distribution of a photometer system, and a spectral reflectance distribution expressed by a linear combination of predetermined output signal functions of said first to fourth sensors;

measuring as a signal at least a part of reflection light from one of a light source whose color temperature is based on the known black body radiation and a fluorescent lamp whose type is to be discriminated, by using each of said first to fourth sensors;

obtaining a spectral reflectance distribution that minimizes a difference between said second reference value and a measurement value obtained by each of said first to fourth sensors, for each light source whose color temperature is based on said known black body radiation and for each fluorescent lamp;

obtaining as a first evaluation value a sum of abnormal components of the thus obtained spectral reflectance distribution whose maximum values exceed 1.0; and

setting, as a result of light source type discrimination, one of a light source whose color temperature is based on said known black body radiation and a fluorescent lamp type corresponding to a minimum value of said first evaluation value.

Claims 7-8 (Canceled)

9. (Currently Amended) ~~The image forming method according to claim 7~~A light source type discriminating method for discriminating a light source type of a photographic light source, comprising the steps of:

providing first to third sensors respectively having spectral sensitivities corresponding to three primary colors;

arranging a fourth sensor having a spectral sensitivity that does not overlap said spectral sensitivities corresponding to said three primary colors, said first to fourth sensors constituting an image pickup system; and

discriminating said light source type of said photographic light source by using information obtained by said first to fourth sensors, wherein:

said first to third sensors for said three primary colors are respectively a red (R) sensor, a green (G) sensor, and a blue (B) sensor; and

when said fourth sensor is assumed to be a sensor X, said fourth sensor X is a sensor whose absorption peak exists between respective absorption peaks of said G sensor and said B sensor and in a region of from 500 nm to 520 nm.

10. (Currently Amended) ~~The image forming method according to claim 7~~A light source type discriminating method for discriminating a light source type of a photographic light source, comprising the steps of:

providing first to third sensors respectively having spectral sensitivities corresponding to three primary colors;

arranging a fourth sensor having a spectral sensitivity that does not overlap said spectral sensitivities corresponding to said three primary colors, said first to fourth sensors constituting an image pickup system; and

discriminating said light source type of said photographic light source by using information obtained by said first to fourth sensors, wherein:

said first to third sensors for said three primary colors are respectively a red (R) sensor, a green (G) sensor, and a blue (B) sensor; and

when said fourth sensor is assumed to be a sensor X, said color conversion method comprises a step of performing correction with respect to a gray portion in said input image or a portion corresponding to the gray portion such that a sensor output Eij^{ZE} (i: pixel position, j: R, G, B, X) corresponding to an estimated light source type becomes a sensor output Eij^{Z0} corresponding to a reference light source.

11. (Original) The image forming method according to claim 10, wherein said correction of from said sensor output Eij^{ZE} to said sensor output Eij^{Z0} comprises a step of obtaining coefficient matrices A and C expressed by the following expression:

$$Ei^{Z0} = A \cdot Ei^{ZE} + C \quad \ldots\ldots \quad (11)$$

provided that

$$Ei^{Z0} = \begin{vmatrix} EiR^{Z0} \\ EiG^{Z0} \\ EiB^{Z0} \\ EiX^{Z0} \end{vmatrix}, \qquad Ei^{ZE} = \begin{vmatrix} EiR^{ZE} \\ EiG^{ZE} \\ EiB^{ZE} \\ EiX^{ZE} \end{vmatrix}$$

where A and C are each a coefficient matrix and C may be zero.

12. (Original) The image forming method according to claim 11, wherein said correction of from said sensor output Eij^{ZE} to said sensor output Eij^{Z0} comprises a step of obtaining coefficient matrices A and C expressed by the following expression:

$$\begin{vmatrix} EiR^{Z0} \\ EiG^{Z0} \\ EiB^{Z0} \\ EiX^{Z0} \end{vmatrix} = \begin{vmatrix} AR & 0 & 0 & 0 \\ 0 & AG & 0 & 0 \\ 0 & 0 & AB & 0 \\ 0 & 0 & 0 & AX \end{vmatrix} \begin{vmatrix} EiR^{ZE} \\ EiG^{ZE} \\ EiB^{ZE} \\ EiX^{ZE} \end{vmatrix} + \begin{vmatrix} CR \\ CG \\ CB \\ CX \end{vmatrix} \cdots\cdots \quad (12)$$

where the coefficient matrix C may be zero.

13. (Original) The image forming method according to claim 11, wherein said correction of from said sensor output Eij^{ZE} to said sensor output Eij^{Z0} comprises a step of obtaining coefficient matrices A and C expressed by the following expression:

$$\begin{vmatrix} EiR^{Z0} \\ EiG^{Z0} \\ EiB^{Z0} \\ EiX^{Z0} \end{vmatrix} = \begin{vmatrix} AR_1 & AR_2 & AR_3 & AR_4 \\ AG_1 & AG_2 & AG_3 & AG_4 \\ AB_1 & AB_2 & AB_3 & AB_4 \\ AX_1 & AX_2 & AX_3 & AX_4 \end{vmatrix} \begin{vmatrix} EiR^{ZE} \\ EiG^{ZE} \\ EiB^{ZE} \\ EiX^{ZE} \end{vmatrix} + \begin{vmatrix} CR \\ CG \\ CB \\ CX \end{vmatrix} \cdots\cdots \quad (13)$$

where the coefficient matrix C may be zero.

14. (Original) A light source energy distribution estimating method comprising the steps of:

obtaining spectral energy distributions of light sources that are each expressed by a linear combination of a plurality of predetermined functions, a spectral sensitivity of a photometer system, and a third reference value determined by one of summation and integration of products of spectral reflectance distributions that are each expressed by a linear combination of a plurality of predetermined functions;

measuring as a signal at least a part of reflection light from a light source whose spectral energy distribution is to be estimated;

obtaining a spectral reflectance distribution minimizing a difference between said third reference value and a measurement value obtained by said measuring step, for each type of light source energy distribution linear combination;

obtaining a sum of abnormal components of the thus obtained spectral reflectance distribution whose maximum values exceed 1.0, as a second evaluation value; and

setting a light source energy distribution linear combination corresponding to a minimum value of said second evaluation value as an energy distribution of said light source whose energy distribution is to be estimated.

15. (Original) The light source energy distribution estimating method according to claim 14, wherein said plurality of predetermined functions are each main component vectors obtained from a plurality of pieces of light source data.

16. (Original) The light source energy distribution estimating method according to claim 15, wherein as said main component vectors, at least first to third main components of main component vectors obtained from said plurality of pieces of light source data are used.

17. (Original) The light source energy distribution estimating method according to claim 14, wherein said third reference value is obtained and stored in a storage unit in advance.

18. (Original) A light source energy distribution estimating apparatus comprising:

storage means for storing spectral energy distributions of light sources that are each expressed by a linear combination of a plurality of predetermined functions, a spectral sensitivity of a photometer system, and a third reference value determined by one of summation and integration of products of spectral reflectance distributions that are each expressed by a linear combination of a plurality of predetermined functions;

measuring means for measuring as a signal at least a part of reflection light from a light source whose spectral energy distribution is to be estimated;

spectral reflectance distribution calculating means for calculating a spectral reflectance distribution minimizing a difference between said third reference value and a measurement value obtained through measurement with said measuring means, for each type of light source energy distribution linear combination;

evaluation value calculating means for calculating a sum of abnormal components of the thus obtained spectral reflectance distribution whose maximum values exceed 1.0, as a second evaluation value; and

estimating means for estimating a light source energy distribution linear combination corresponding to a minimum value of said second evaluation value calculated by said evaluation value calculating means, as an energy distribution of said light source whose energy distribution is to be estimated.

19. (Original) The light source energy distribution estimating apparatus according to claim 18, wherein said plurality of predetermined functions are each main component vectors obtained from a plurality of pieces of light source data.

20. (Original) The light source energy distribution estimating apparatus according to claim 19, wherein as said main component vectors, at least first to third main components of main component vectors obtained from said plurality of pieces of light source data are used.

21. (Original) An exposure amount determining method comprising the step of:

determining an exposure amount for printing an image onto a duplicating sensitive material so that gray of an image to be printed of a photographic film becomes gray under an estimated light source spectral energy distribution, based on information on said estimated light source spectral energy distribution estimated with a light source energy distribution estimating method and photometric data obtained by photometrically determining at least a part of an image which is photographed on said photographic film under given photographing conditions and whose photographic light source energy distribution is to be estimated,

wherein said light source energy distribution estimating method comprises the steps of:

obtaining spectral energy distributions of light sources that are each expressed by a linear combination of a plurality of predetermined functions, a spectral sensitivity of a photometer system, and a third reference value determined by one of summation and integration of products

of spectral reflectance distributions that are each expressed by a linear combination of a plurality of predetermined functions;

measuring as a signal at least a part of reflection light from a light source whose spectral energy distribution is to be estimated;

obtaining a spectral reflectance distribution minimizing a difference between said third reference value and a measurement value obtained by said measuring step, for each type of light source energy distribution linear combination;

obtaining a sum of abnormal components of the thus obtained spectral reflectance distribution whose maximum values exceed 1.0, as a second evaluation value; and

setting a light source energy distribution linear combination corresponding to a minimum value of said second evaluation value as an energy distribution of said light source whose energy distribution is to be estimated.